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Whipple

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(54) **POWERED TISSUE RESECTING DEVICE**

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(73) Assignee: **COVIDIEN LP**, Mansfield, MA (US)

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(51) **Int. Cl.**

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(52) **U.S. Cl.**

CPC ***A61B 17/32002*** (2013.01); ***A61B 17/3205*** (2013.01); *A61B 17/42* (2013.01); *A61B 2017/00477* (2013.01); *A61B 2017/2948* (2013.01); *A61B 2017/320028* (2013.01); *A61B 2017/320032* (2013.01); *A61B 2090/0813* (2016.02); *A61B 2217/005* (2013.01); *A61B 2217/007* (2013.01)

(58) **Field of Classification Search**

CPC .. A61B 17/32002; A61B 2017/320028; A61B 2017/320032; A61B 2017/00477; A61B 2017/0046; A61B 2217/005; A61B 2217/007

See application file for complete search history.

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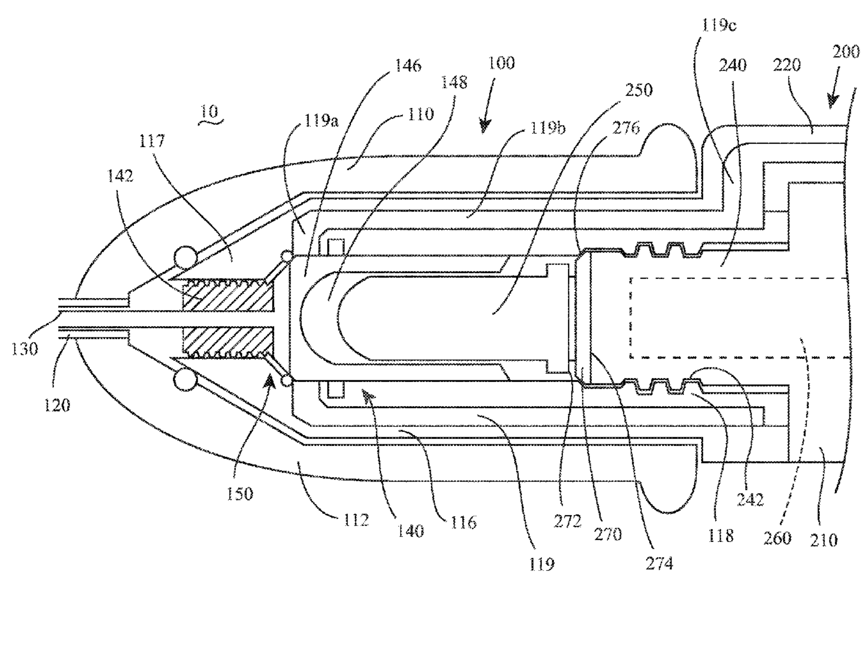
(74) *Attorney, Agent, or Firm* — Carter, DeLuca & Farrell LLP

(57) **ABSTRACT**

A tissue resecting device includes an end effector assembly including a proximal hub housing and a cutting member extending distally from the proximal hub housing, and a handpiece assembly. The handpiece assembly includes a handle housing, a drive casing extending distally from the handle housing, a drive rotor extending through and distally from the drive casing, and a seal ring disposed about the drive rotor. In an at-rest position, the seal ring is sealingly engaged between the drive casing and the drive rotor to inhibit fluid ingress into the annular space. Upon engagement of the end effector assembly with the handpiece assembly, a portion of the proximal hub housing is configured to urge the seal ring from the at-rest position to a displaced position wherein the seal ring is displaced from the drive rotor to reduce friction therebetween upon rotation of the drive rotor relative to the drive casing.

5 Claims, 5 Drawing Sheets



(51) **Int. Cl.**
A61B 17/29 (2006.01)
A61B 90/00 (2016.01)

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FIG. 1

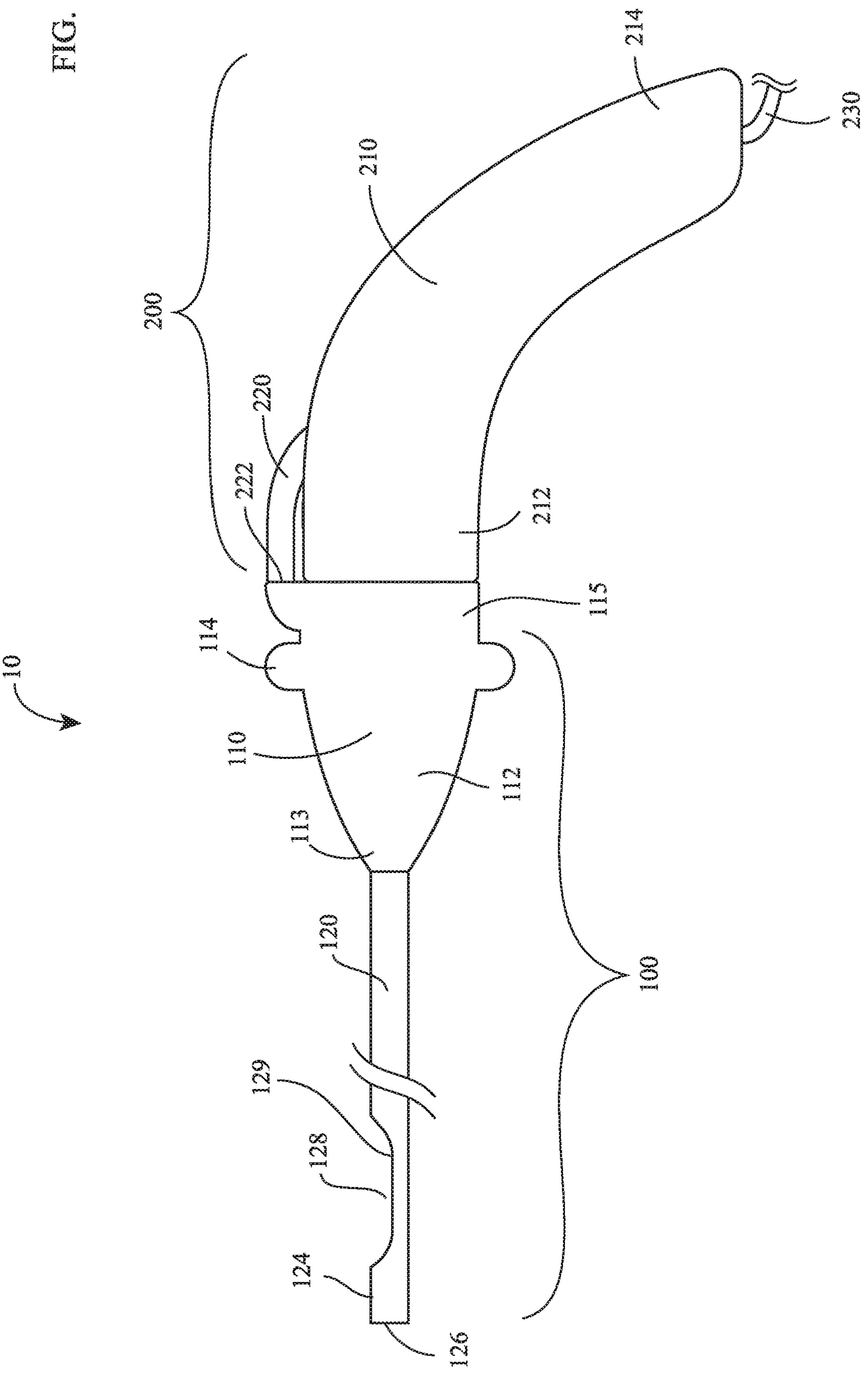
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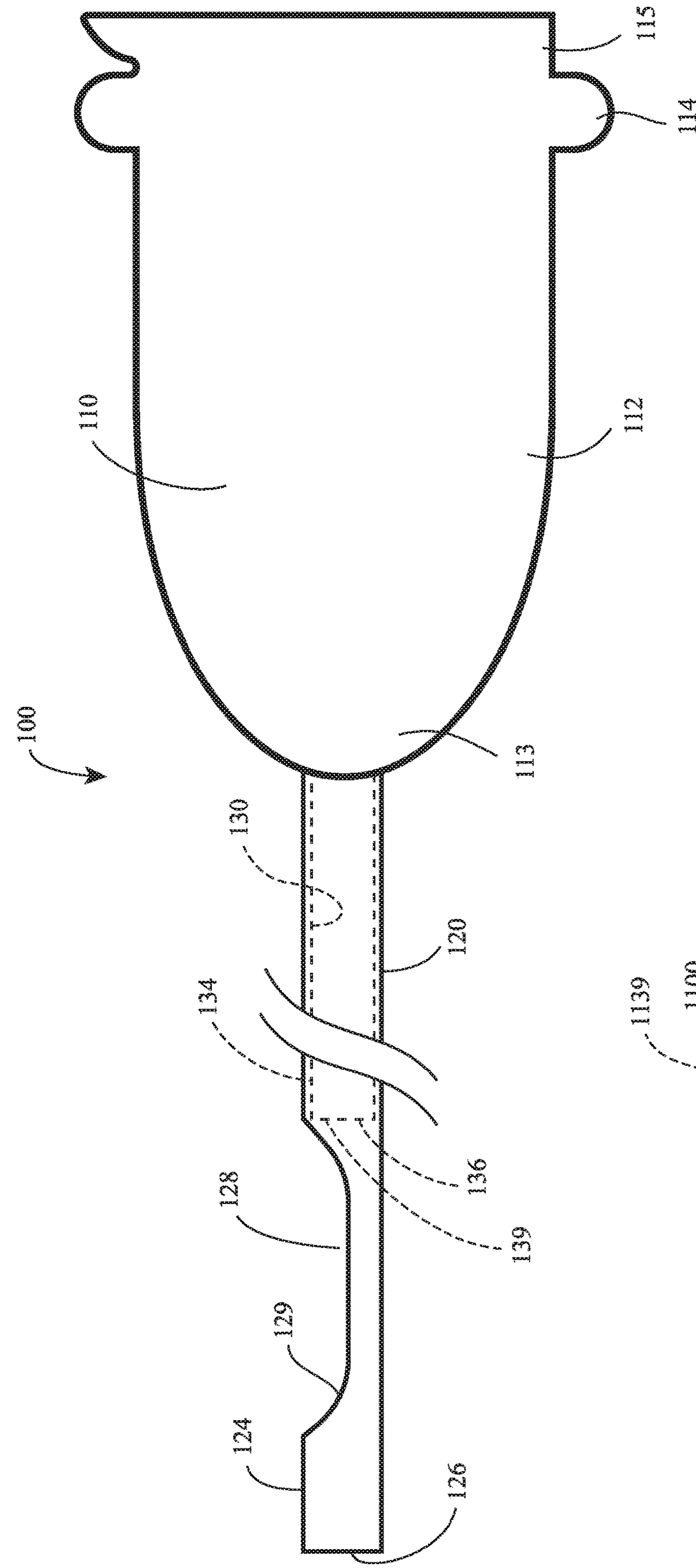
FIG. 2A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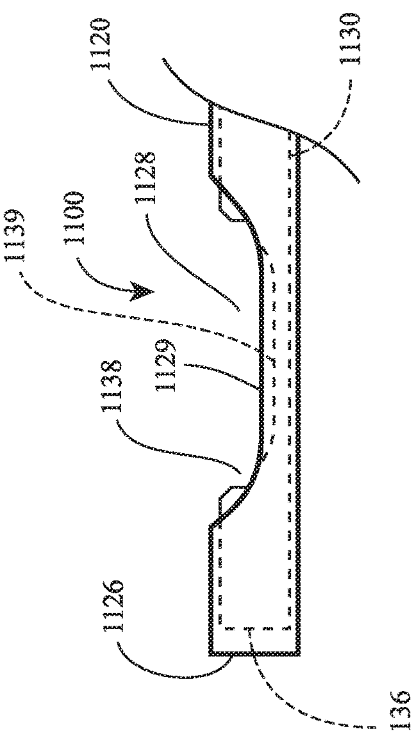
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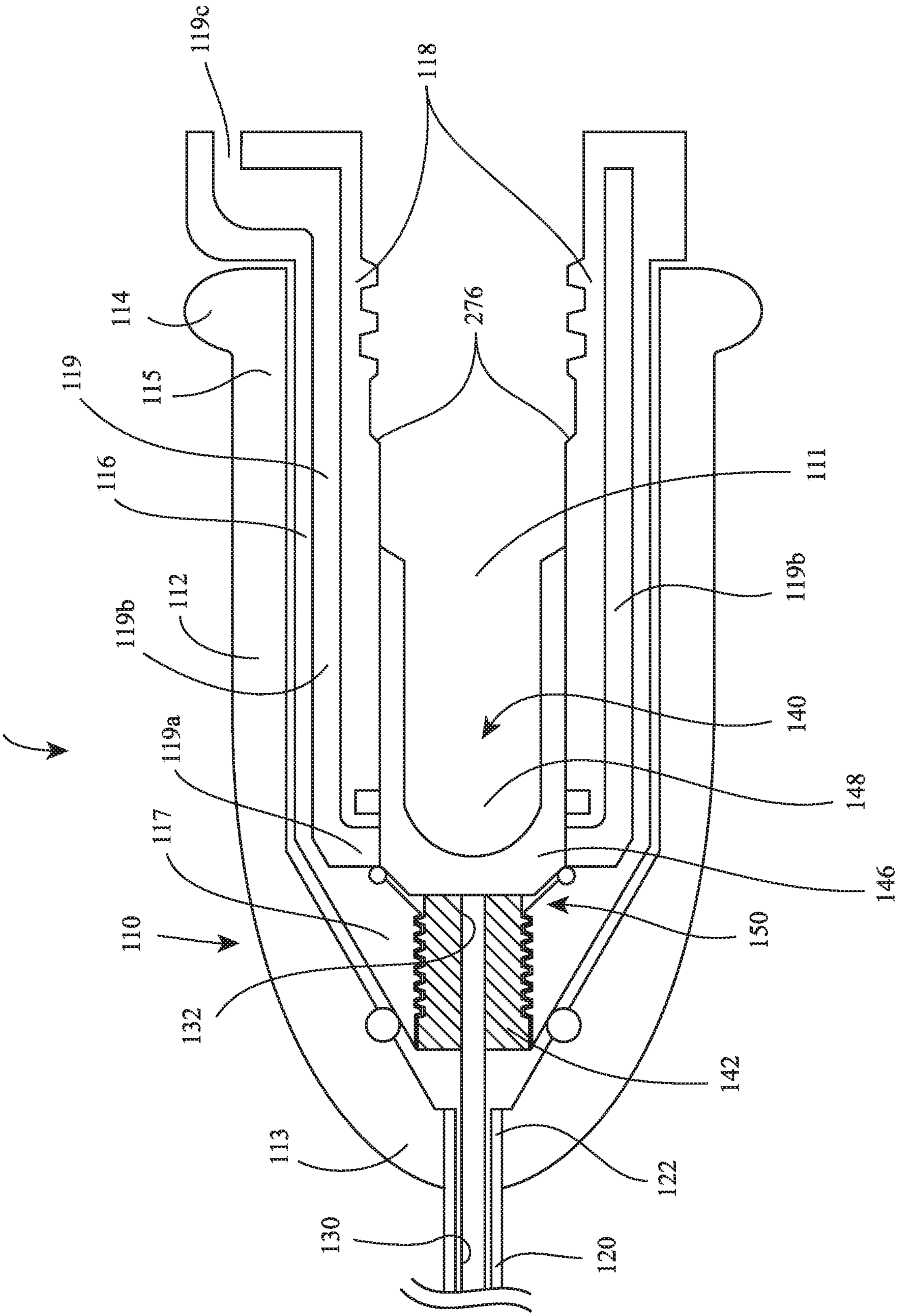
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FIG. 4

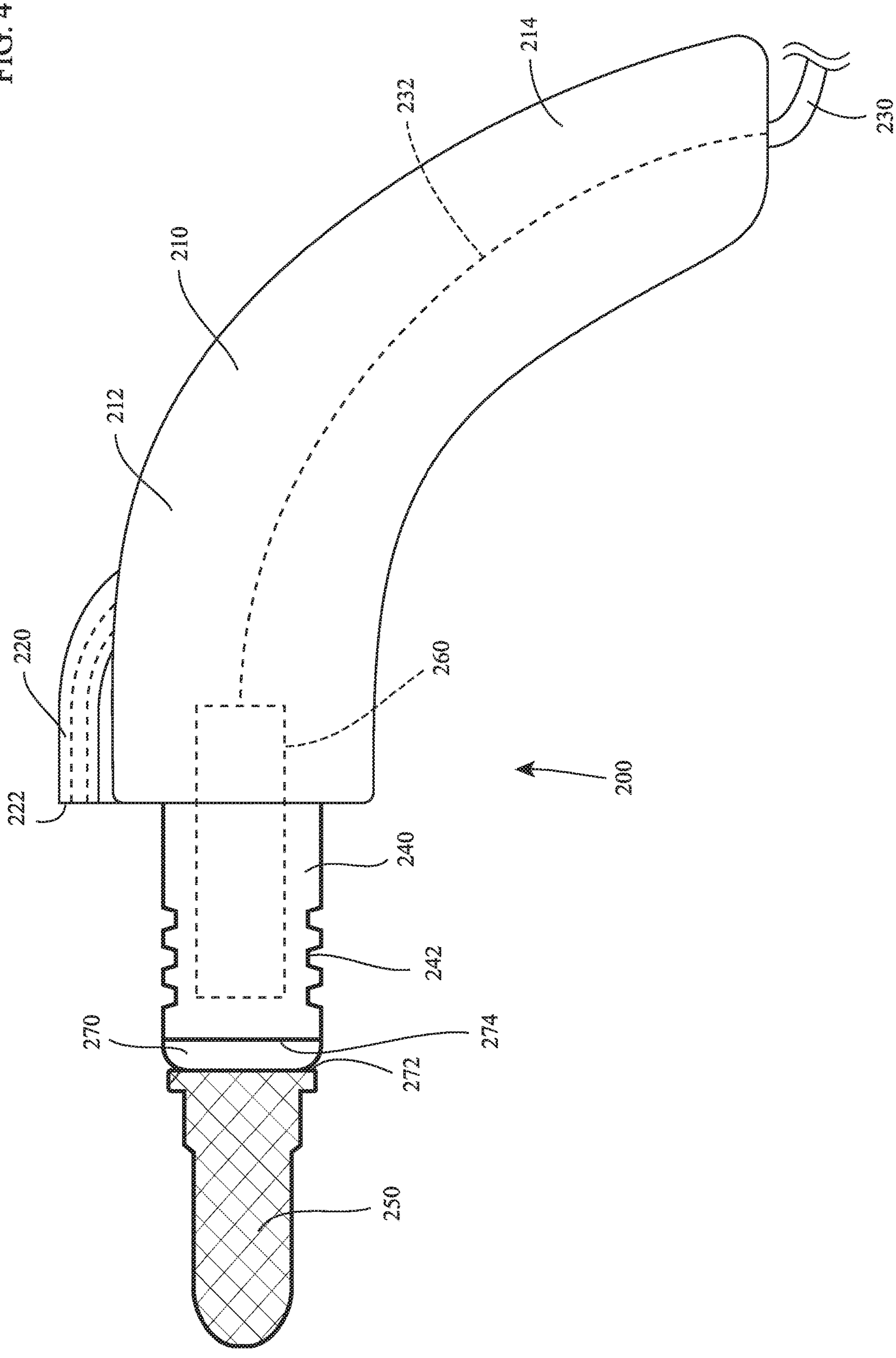

FIG. 5A

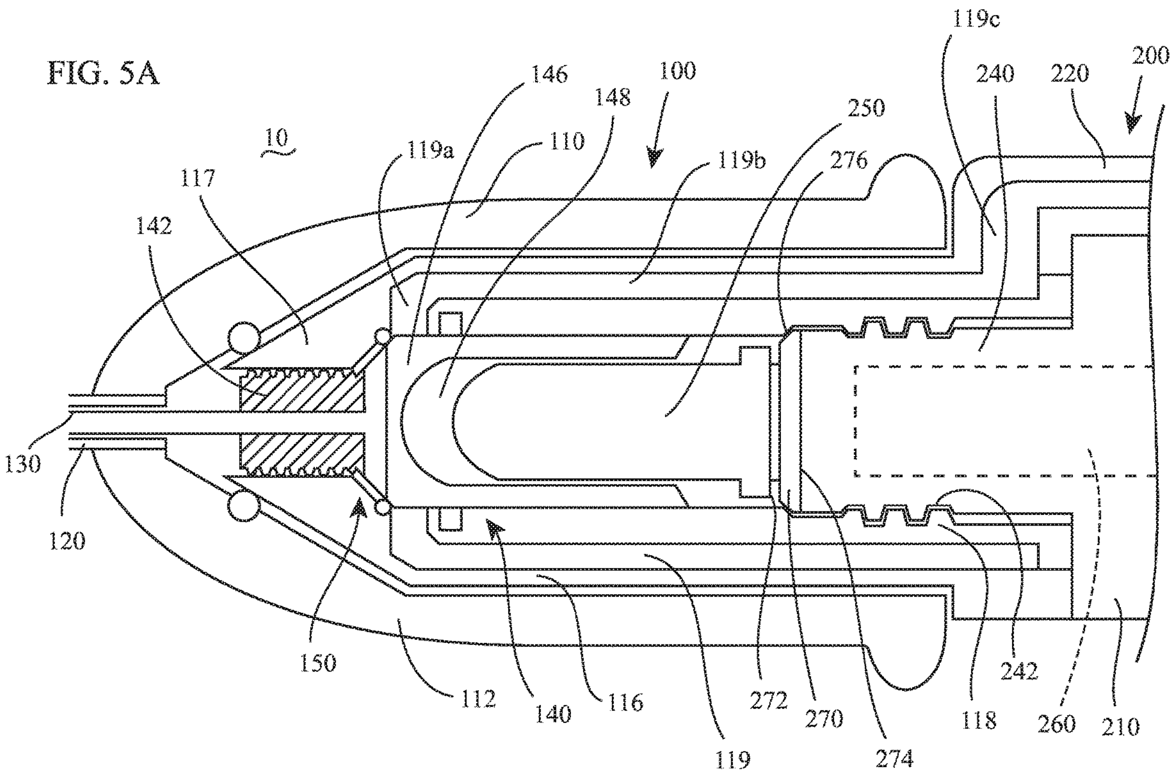

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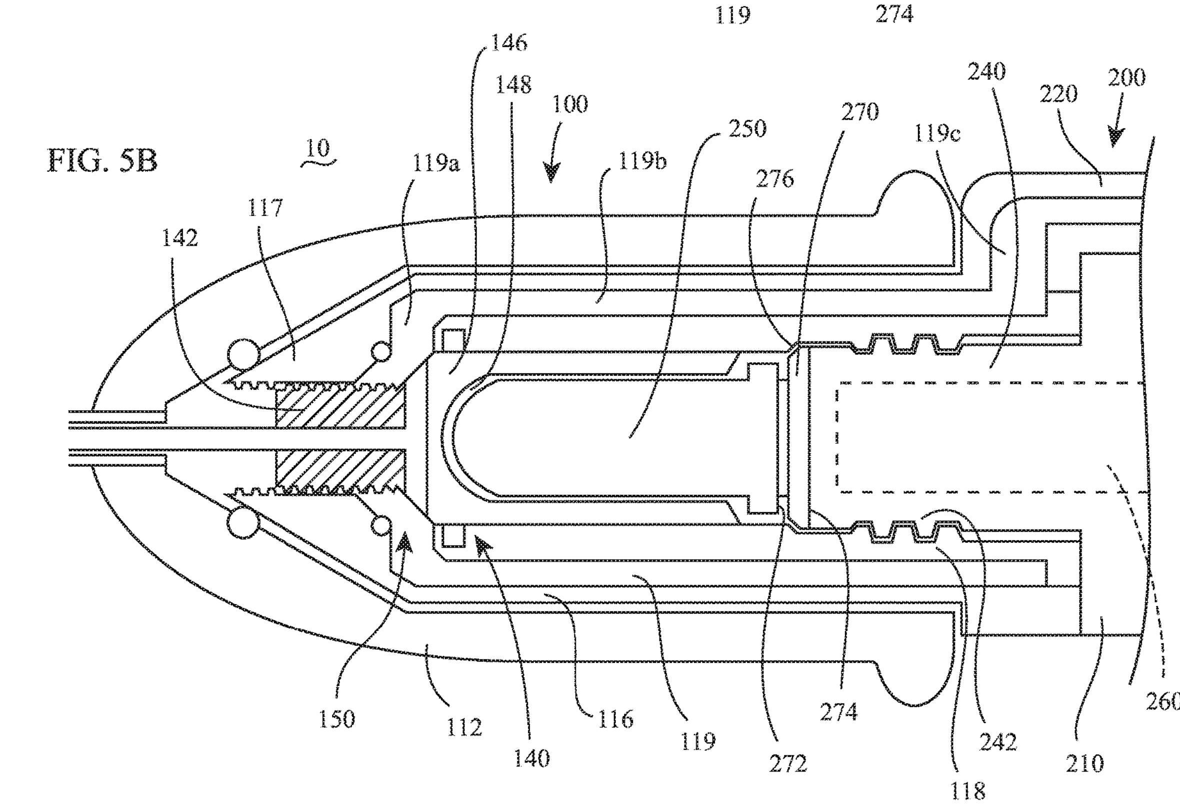
FIG. 5B



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POWERED TISSUE RESECTING DEVICE

BACKGROUND

1. Technical Field

The present disclosure relates generally to the field of tissue resection. In particular, the present disclosure relates to a powered tissue resecting device.

2. Background of Related Art

Tissue resection may be performed endoscopically within an organ, such as a uterus, by inserting an endoscope (or hysteroscope) into the uterus and passing a tissue resection device through the endoscope (or hysteroscope) and into the uterus. With respect to such endoscopic tissue resection procedures, it often is desirable to distend the uterus with a fluid, for example, saline, sorbitol, or glycine. The inflow and outflow of the fluid during the procedure maintains the uterus in a distended state and flushes tissue and other debris from within the uterus to maintain a visible working space.

SUMMARY

As used herein, the term "distal" refers to the portion that is described which is further from a user, while the term "proximal" refers to the portion that is described which is closer to a user. Further, to the extent consistent, any or all of the aspects described herein may be used in conjunction with any or all of the other aspects described herein.

Provided in accordance with aspects of the present disclosure is a tissue resecting device including an end effector assembly and a handpiece assembly. The end effector assembly includes a proximal hub housing and a cutting member extending distally from the proximal hub housing. The handpiece assembly includes a handle housing, a drive casing extending distally from the handle housing, a drive rotor extending through and distally from the drive casing, and a seal ring disposed about the drive rotor. In an at-rest position, the seal ring is sealingly engaged between the drive casing and the drive rotor to inhibit fluid ingress into the annular space. The end effector assembly is releasably engagable with the handpiece assembly. Upon engagement of the end effector assembly with the handpiece assembly, a portion of the proximal hub housing is configured to urge the seal ring from the at-rest position to a displaced position wherein the seal ring is displaced from the drive rotor to reduce friction therebetween upon rotation of the drive rotor relative to the drive casing.

In an aspect of the present disclosure, the end effector assembly further includes an inner core disposed within the proximal hub housing. In such aspects, the cutting member is coupled to the inner core and the inner core is configured to couple to the drive rotor upon engagement of the end effector assembly with the handpiece assembly such that rotation of the drive rotor drives the cutting member. The inner core, in aspects, is configured such that rotation of the drive rotor drives rotation and reciprocation of the cutting member.

In another aspect of the present disclosure, the end effector assembly further includes a fixed outer shaft extending distally from the proximal hub housing and disposed about the cutting member.

In yet another aspect of the present disclosure, the proximal hub housing defines bayonet threading and the drive casing defines bayonet threading configured to engage the bayonet threading of the proximal hub housing to engage the end effector assembly with the handpiece assembly.

In still another aspect of the present disclosure, the handpiece assembly further includes a motor disposed within the handle housing and configured to drive rotation of the drive rotor.

Another tissue resecting device provided in accordance with aspects of the present disclosure includes a handpiece assembly including a drive rotor and an end effector assembly configured to engage the handpiece assembly. The end effector assembly defines a longitudinal axis and includes a proximal hub housing defining a fluid channel including an input disposed in a radially-inward facing direction relative to the longitudinal axis and an output, an inner core operably disposed within the proximal hub housing and configured to couple to the drive rotor such that rotation of the drive rotor effects rotation and reciprocation of the inner core relative to the proximal hub housing, a cutting member extending distally from the proximal hub housing and coupled to the inner core such that rotation and reciprocation of the inner core rotation relative to the proximal hub housing effects rotation and reciprocation of the cutting member relative to the proximal hub housing, and a valve disposed within the proximal hub housing. The valve is transitionable between an open position, permitting fluid flow from the cutting member into the input of the fluid channel, and a closed position, inhibiting fluid flow from the cutting member into the input of the fluid channel. The valve is disposed in the open position during a first portion of the reciprocation motion of the inner core and in the closed position during a second, different portion of the reciprocation motion of the inner core. Transitioning of the valve from the closed position to the open position establishes a surge of centrifugal force to urge fluid from the cutting member into the input of the fluid channel.

In an aspect of the present disclosure, the handpiece assembly further includes a fluid conduit configured to couple to the output of the fluid channel to receive fluid therefrom. In such aspects, the fluid conduit may be adapted to connect to a suction source to apply suction through the fluid conduit, the fluid channel, and the cutting member when the valve is disposed in the open position. Further, the surge of centrifugal force may be greater than a steady-state suction force applied from the suction source.

In another aspect of the present disclosure, the inner core is configured to reciprocate through the proximal hub housing between a proximal position and a distal position. In such aspects, the valve is disposed in the open position when the inner core is disposed towards the proximal position, and the valve is disposed in the closed position when the inner core is disposed towards the distal position.

In yet another aspect of the present disclosure, the end effector assembly further includes a fixed outer shaft extending distally from the proximal hub housing and disposed about the cutting member.

In still another aspect of the present disclosure, the valve is defined by the inner core and an inner housing of the proximal hub housing.

Another tissue resecting device provided in accordance with aspects of the present disclosure includes an end effector assembly including a proximal hub housing and a cutting member extending distally from the proximal hub housing. The proximal hub housing defines a fluid channel therethrough configured to enable withdrawal of fluid from the cutting member. A portion of the proximal hub housing adjacent the fluid channel is formed from a heat sink material. The tissue resecting device further includes a handpiece assembly including a handle housing, a drive rotor extending distally from the handle housing and configured to couple the cutting member to drive the cutting member, a motor disposed within the handle housing and configured to drive the drive rotor to thereby drive the cutting member, and a drive casing extending distally from the handle housing and disposed about a portion of the drive rotor. A portion of the drive casing is formed from a heat sink material. The proximal hub housing is configured to engage the drive casing to releasably engage the end effector assembly with the handpiece assembly. With the end effector assembly engaged with the handpiece assembly, the portion of the proximal hub housing and the portion of the drive casing are disposed in direct thermal communication with one another to form a heat sink for conducting heat from the motor to fluid flowing through the fluid channel, thereby helping to cool the motor.

In an aspect of the present disclosure, the proximal hub housing defines bayonet threading and the drive casing defines bayonet threading configured to engage the bayonet threading of the proximal hub housing to engage the end effector assembly with the handpiece assembly and bring the portion of the proximal hub housing and the portion of the drive casing into direct thermal communication with one another to form the heat sink.

In another aspect of the present disclosure, the heat sink material of the portion of the proximal hub housing and/or the heat sink material of the portion of the drive casing is a thermally-conductive metal.

In still another aspect of the present disclosure, the motor is configured to drive rotation of the drive rotor.

In yet another aspect of the present disclosure, the end effector assembly further includes an inner core configured to couple the drive rotor with the cutting member. The inner core is configured such that rotation of the drive rotor drives rotation and reciprocation of the cutting member.

In still yet another aspect of the present disclosure, the end effector assembly further includes a fixed outer shaft extending distally from the proximal hub housing and disposed about the cutting member.

In another aspect of the present disclosure, the handpiece assembly further includes a fluid conduit configured to couple to an output of the fluid channel to receive fluid therefrom. The fluid conduit is adapted to connect to a suction source to apply suction through the fluid conduit, the fluid channel, and the cutting member to withdraw fluid therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

Various aspects and features of the present disclosure are described hereinbelow with reference to the drawings wherein like numerals designate identical or corresponding elements in each of the several views and:

FIG. **1** is a side view of a tissue resecting device provide in accordance with aspects of the present disclosure;

FIG. **2**A is a side view of an end effector assembly of the tissue resecting device of FIG. **1**;

FIG. **2**B is a side view of a distal end portion of another end effector assembly configured for use with the tissue resecting device of FIG. **1**;

FIG. **3** is a longitudinal, cross-sectional view of a proximal portion of the end effector assembly of FIG. **2**A;

FIG. **4** is a side view of a handpiece assembly of the tissue resecting device of FIG. **1**;

FIG. **5**A is a longitudinal, cross-sectional view illustrating the proximal portion of the end effector assembly engaged with a distal portion of the handpiece assembly, wherein internal operating components thereof are in a first position during use; and

FIG. **5**B is a longitudinal, cross-sectional view illustrating the proximal portion of the end effector assembly engaged with the distal portion of the handpiece assembly, wherein the internal operating components thereof are in a second position during use.

DETAILED DESCRIPTION

Referring generally to FIG. **1**, a tissue resecting device **10** provided in accordance with the present disclosure and configured to resect tissue includes an end effector assembly **100** and a handpiece assembly **200**. Tissue resecting device **10** is adapted to connect to a control unit (not shown) to provide power and control functionality to tissue resecting device **10**, although tissue resecting device **10** may alternatively or additionally include controls associated with handpiece assembly **200** and/or a power source, e.g., battery, disposed within handpiece assembly **200**. Tissue resecting device **10** is further adapted to connect to a fluid management system (not shown) for removing fluid, tissue, and debris from a surgical site via tissue resecting device **10**. The control unit and fluid management system may be integral with one another, coupled to one another, or separate from one another.

With continued reference to FIG. **1**, tissue resecting device **10** may be configured as a single-use device that is discarded after use or sent to a manufacturer for reprocessing, a reusable device capable of being cleaned and/or sterilized for repeated use by the end-user, or a partially-single-use, partially-reusable device. With respect to partially-single-use, partially-reusable configurations, handpiece assembly **200** may be configured as a cleanable/sterilizable, reusable component, while end effector assembly **100** is configured as a single-use, disposable/reprocessable component. In either of the above configurations, end effector assembly **100** is configured to releasably engage handpiece assembly **200** to facilitate disposal/reprocessing of any single-use components and cleaning and/or sterilization of any reusable components. Further, enabling releasable engagement of end effector assembly **100** with handpiece assembly **200** allows for use of different end effector assemblies, e.g., end effector assembly **100** (FIGS. **1** and **2**A) or end effector assembly **1100** (FIG. **2**B), with handpiece assembly **200**.

Referring to FIGS. **2**A and **3**, end effector assembly **100** includes a proximal hub housing **110**, an elongated outer shaft **120** fixedly engaged with and extending distally from proximal hub housing **110**, an inner cutting shaft **130** movable disposed within elongated outer shaft **120**, and an inner drive core **140** operably disposed within proximal hub housing **110** and coupled to inner cutting shaft **130** such that rotational input imparted to inner drive core **140**, e.g., via handpiece assembly **200**, as detailed below, drives reciprocation and rotation of inner cutting shaft **130** within and relative to elongated outer shaft **120**.

Proximal hub housing **110** of end effector assembly **100** includes an outer housing **112** and an inner housing **116** sealingly engaged within outer housing **112**. Outer housing **112** receives and fixedly engages a proximal end portion **122** of elongated outer shaft **120** therein at a distal nose **113** of outer housing **112**. Outer housing **112** further includes an annular protrusion **114** defined at proximal base **115** of outer housing **112** to facilitate grasping and manipulating proximal hub housing **110**. Inner housing **116** includes a threaded distal nose **117**, proximal bayonet threading **118** disposed within and facing radially-inwardly into an interior cavity **111** of proximal hub housing **110**, and an annular channel **119** disposed about interior cavity **111** and defining a radially-inwardly-facing open distal end **119***a*, a ring-shaped body **119***b*, and a proximal exit port **119***c*. Inner housing **116**, or at least a portion thereof, is formed from a heat sink material, e.g., a thermally-conductive material such as a metal, to serve as a heat sink for motor **260** of handpiece assembly **200** (FIG. **4**), as detailed below.

Elongated outer shaft **120** of end effector assembly **100**, as noted above, includes a proximal end portion **122** fixedly engaged with outer housing **112** of proximal hub housing **110**. Elongated outer shaft **120** further includes a distal end portion **124** defining a closed distal end **126** and a window **128** proximally-spaced from closed distal end **126**. Window **128** provides access to the interior of elongated outer shaft **120** and may be surrounded by a cutting edge **129** about the outer perimeter of window **128** so as to facilitate cutting of tissue passing through window **128** and into elongated outer shaft **120**.

Inner cutting shaft **130** defines a proximal end portion **132** and a distal end portion **134** defining an open distal end **136**. Inner cutting shaft **130** defines an annular cutting edge **138** surrounding open distal end **136** so as to facilitate cutting of tissue passing into inner cutting shaft **130** via open distal end **136**. Inner cutting shaft **130**, as noted above, is rotatable and reciprocatable within and relative to elongated outer shaft **120**. More specifically, inner cutting shaft **130** is configured to reciprocate and rotate such that annular cutting edge **138** is exposed within window **128** of elongated outer shaft **120** during at least a portion of the reciprocation motion of inner cutting shaft **130** to enable cutting of tissue therewith. As detailed below, suction is provided to facilitate drawing tissue into window **128** and, thus, cutting and removal of tissue through inner cutting shaft **130**.

With momentary reference to FIG. **2**B, another embodiment of an end effector assembly **1100** configured for use with tissue resecting device **10** (FIG. **1**) is shown. End effector assembly **1100** is similar to and may include any of the features of end effector assembly **100** (FIG. **2**A), except that, rather than reciprocation and rotation, inner cutting shaft **1130** of end effector assembly **1100** is longitudinally fixed and rotatable relative to elongated outer shaft **1120**. End effector assembly **1100** further differs from end effector assembly **100** (FIG. **2**A) in that elongated outer shaft **1120** and inner cutting shaft **1130** both define window **1128**, **1138** proximally-spaced from the respective distal end **1126**, **1136** thereof. Window **1128** and/or window **1138** may be surrounded by a cutting edge **1129**, **1139**, respectively, configured to facilitate cutting of tissue passing through windows **1128**, **1138** upon relative rotation between windows **1128**, **1138**, e.g., as a result of rotation of inner cutting shaft **1130** relative to elongated outer shaft **1120**. Other suitable end effector assemblies including various different elongated outer shaft and inner cutting shaft configurations are also contemplated.

Referring again to FIGS. **2**A and **3**, inner drive core **140** of end effector assembly **100** includes a threaded ferrule **142** defining threading on an exterior thereof and a receiver **146** engaged to and extending proximally from threaded ferrule **142**. Threaded ferrule **142** is engaged about proximal end portion **132** of inner cutting shaft **130** such that rotation of threaded ferrule **142** effects corresponding rotation of inner cutting shaft **130**. Threaded ferrule **142** is disposed within threaded distal nose **117** of inner housing **116** with the respective threads thereof disposed in meshed engagement with one another. As a result of this configuration, rotational input to threaded ferrule **142** effects rotation and reciprocation of threaded ferrule **142** through and relative to proximal hub housing **110** which, in turn, rotates and reciprocates inner cutting shaft **130** relative to elongated outer shaft **120**.

Receiver **146** of inner drive core **140**, as noted above, is engaged to and extends proximally from threaded ferrule **142**. Receiver **146** is slidably and rotatably disposed within interior cavity **111** of proximal hub housing **110** and defines a slot **148** having a non-circular cross-section. Slot **148** is configured to receive a drive rotor **250** of handpiece assembly **200** (see FIGS. **4**-**5**B) in fixed rotational orientation relative thereto such that rotation of drive rotor **250** is imparted to receiver **146** which, in turn, is imparted to threaded ferrule **142** to rotate and reciprocate inner cutting shaft **130** relative to elongated outer shaft **120**.

With continued reference to FIGS. **2**A and **3**, as noted above, annular channel **119** defined within inner housing **116** has a radially-inwardly-facing open distal end **119***a*, a ring-shaped body **119***b*, and a proximal exit port **119***c*. Radially-inwardly-facing open distal end **119***a* is oriented perpendicularly relative to a longitudinal axis of elongated outer shaft **120** and inner cutting shaft **130** and, thus, perpendicular to the direction of fluid, tissue, and debris flow through inner cutting shaft **130**. Further, inner housing **116** and receiver **146** cooperate to define a valve **150** between radially-inwardly-facing open distal end **119***a* of annular channel **119** and the open proximal end of inner cutting shaft **130**. More specifically, as receiver **146** reciprocates through and relative to inner housing **116**, receiver **146** is moved from a proximal position, corresponding to an open position of valve **150** (see FIG. **5**B), enabling fluid communication between the interior of inner cutting shaft **130** and annular channel **119**, and a distal position, corresponding to a closed position of valve **150** (FIG. **5**A), wherein receiver **146** abuts threaded distal nose **117** of inner housing **116** in sealing engagement therewith to inhibit fluid communication between the interior of inner cutting shaft **130** and annular channel **119**. Thus, during use, when end effector assembly **100** is activated such that inner cutting shaft **130** is rotating and reciprocating, valve **150** is open during a portion of the rotating and reciprocating, and is closed during another portion of the rotating and reciprocating. When valve **150** is open, fluid, tissue and debris suctioned into inner cutting shaft **130** are be evacuated from end effector assembly **100** via annular channel **119**, as detailed below.

Turning now to FIGS. **1**, **3** and **4**, handpiece assembly **200** generally includes a handle housing **210**, a fluid return conduit **220** disposed on handle housing **210**, a cable **230** coupled to handle housing **210**, a drive casing **240** extending distally from handle housing **210**, a drive rotor **250** extending distally from drive casing **240**, and a motor **260** disposed within at least a portion of drive casing **240** and/or handle housing **210**. Handpiece assembly **200** may further include one or more controls (not shown) disposed on or operably associated with handle housing **210** to facilitate activation of tissue resecting device **10**.

Handle housing **210** defines a pistol-grip configuration, although other configurations are also contemplated, and includes a barrel portion **212** and a fixed handle portion **214**. Fluid return conduit **220** extends alongside barrel portion **212** of handle housing **210** and may be formed with barrel portion **212** or otherwise engaged thereto. Fluid return conduit **220** defines an open distal end **222** that is configured to abut and operably couple with proximal exit port **119***c* of end effector assembly **100** (FIGS. **2**A and **3**) upon engagement of end effector assembly **100** with handpiece assembly

200 so as to define a continuous fluid path from end effector assembly 100, through fluid return conduit 220, to a collection receptacle of the fluid management system (not shown). To this end, fluid return conduit 220 may be coupled at its proximal end to tubing (not shown) or other suitable structure configured to direct fluid from fluid return conduit 220 to the fluid management system.

Cable 230 extends proximally from fixed handle portion 214 of handle housing 210 and is configured to connect to the control unit (not shown) to provide power and control functionality to tissue resecting device 10. Cable 230, more specifically, houses one or more wires 232 that extend into handle housing 210 and connect to the controls thereof and/or motor 260 to power motor 260 and control operation of tissue resecting device 10 in accordance with controls associated with handpiece assembly 200, the control unit, and/or other remote control devices, e.g., a footswitch (not shown).

The drive casing 240, as noted above, extend distally from handle housing 210. Drive casing 240, more specifically, surrounds at least a portion of motor 260, is disposed in thermal communication with motor 260, and is formed from a heat sink material, e.g., a thermally-conductive material such as a metal, to serve as a heat sink for motor 260. Drive casing 240 further defines external bayonet threading 242 therein that is configured to engage proximal bayonet threading 118 of inner housing 116 of end effector assembly 100 to releasably engage end effector assembly 100 with handpiece assembly 200.

Drive rotor 250 extends distally from drive casing 240, as noted above, and defines a non-circular cross-section complementary to that of slot 148 of receiver 146 of end effector assembly 100 such that, upon engagement of end effector assembly 100 with handpiece assembly 200, drive rotor 250 is received within slot 148 of receiver 146 in fixed rotational orientation relative thereto. As such, rotation of drive rotor 250 is imparted to receiver 146 which, in turn, is imparted to threaded ferrule 142 to rotate and reciprocate inner cutting shaft 130 relative to elongated outer shaft 120. An annular gap is defined between drive rotor 250 and drive casing 240 to enable drive rotor 250 to rotate relative to drive casing 240 with minimal friction therebetween.

Referring to FIG. 4, a seal ring 270 formed from an elastomeric material is disposed, in an at-rest position, about drive rotor 250 between a proximally-facing shoulder 272 of drive rotor 250 and a distally-facing surface 274 of drive casing 240 so as to seal the annular gap defined between drive rotor 250 and drive casing 240. Thus, fluids are inhibited from entering the annular gap defined between drive rotor 250 and drive casing 240 such as, for example, during sterilization and/or cleaning of handpiece assembly 200 for reuse.

Turning to FIGS. 5A-5B, in conjunction with FIGS. 1, 3, and 4, in order to engage end effector assembly 100 with handpiece assembly 200, end effector assembly 100 is approximated and rotated relative to handpiece assembly 200 to engage external bayonet threading 242 of drive casing 240 with proximal bayonet threading 118 of inner housing 116 and such that open distal end 222 of fluid return conduit 220 is operably coupled with proximal exit port 119*c* of annular channel 119 and drive rotor 250 is received within receiver 146 in fixed rotational engagement therewith. In this engaged condition, fluid, tissue, and debris are permitted to flow (when valve 150 is disposed in the open position) from inner cutting shaft 130 through annular channel 119 and into fluid return conduit 220 for ultimate collection at the fluid management system. Further, in this engaged condition, inner housing 116 and drive casing 240 are thus disposed in contact with one another to together serve as a heat sink conducting heat away from motor 260 to fluid passing through annular channel 119 defined within inner housing 116 during use, thus helping to cool motor 260.

Additionally, upon engagement of end effector assembly 100 with handpiece assembly 200, a ramped surface 276 of inner housing 116 urges seal ring 270 proximally such that seal ring 270 is displaced from proximally-facing shoulder 272 of drive rotor 250 and removed from contact with drive rotor 250. As such, friction between seal ring 270, drive rotor 250, and drive casing 240 during use, e.g., rotation of drive rotor 250 relative to drive casing 240, is substantially reduced if not eliminated. Upon disengagement of end effector assembly 100 from handpiece assembly 200, seal ring 270 is returned under bias to its at-rest position.

Referring generally to FIGS. 1, 2A, and 3-5B, prior to use, tissue resecting device 10 is assembled by engaging end effector assembly 100 with handpiece assembly 200, as detailed above. Further, cable 230 is connected to the control unit and fluid return conduit 220 is connected to the fluid management system. Once this is achieved, tissue resecting device 10 is ready for use. In use, tissue resecting device 10 is positioned within an internal body cavity or organ, e.g., a uterus, such that the distal end portion of end effector assembly 100 is positioned adjacent tissue to be removed. Tissue resecting device 10 may be inserted through an endoscope, e.g., a hysteroscope, or other device, or may be used independently.

Once tissue resecting device 10 is positioned as desired adjacent tissue to be removed, tissue resecting device 10 is activated. Activation of tissue resecting device 10 powers motor 260 which serves to rotationally drive drive rotor 250. Rotation of drive rotor 250, in turn, provides rotational input to receiver 146 such that threaded ferrule 142 is rotated and reciprocated to thereby rotate and reciprocate inner cutting shaft 130 relative to elongated outer shaft 120. Activation of tissue resecting device 10 also serves to activate suction through fluid return conduit 220, thereby applying suction through inner cutting shaft 130. With such suction applied, tissue is drawn through window 128 of elongated outer shaft 120 and into inner cutting shaft 130, while cutting edges 129, 138 facilitate cutting of tissue as it passes through window 128 and into inner cutting shaft 130. The suction also draws fluid and debris into inner cutting shaft 130. Tissue resecting device 10 is utilized until the desired tissue is removed from the internal body cavity or organ.

The tissue, fluid, and debris suctioned through inner cutting shaft 130 travel proximally through inner cutting shaft 130, eventually reaching valve 150. With valve 150 in the open position (FIG. 5B), the tissue, fluid, and debris are urged radially outwardly, into and through the radially-inwardly-facing open distal end 119*a* of annular channel 119 and eventually passing through ring-shaped body 119*b* of annular channel 119, proximal exit port 119*c* of annular channel 119, and into fluid return conduit 220. When valve 150 is disposed in the closed position (FIG. 5A), the tissue, fluid, and debris do not pass therethrough; however, upon re-opening of valve 150, a centrifugal force surge (created due to the rotation of receiver 146 relative to inner housing 116 and the perpendicular orientation open distal end 119*a* of annular channel 119 relative to the longitudinal axis of elongated outer shaft 120) above the steady-state suction force urges the tissue, fluid, and debris radially outwardly into open distal end 119*a* of annular channel 119 such that any collected tissue, fluid, and debris is taken therewith under this force surge, thus clearing any collected tissue, fluid, and debris and inhibiting clogging within proximal hub housing **110** of end effector assembly **100**. Further, as noted above, the fluid (and tissue and debris) passing proximally through annular channel **119** also serves to absorb heat conducted away from motor **260** via the heat sink formed from the engagement of inner housing **116** and drive casing **240**, thus helping to cool motor **260** during use. In addition, as also noted above, seal ring **270** is maintained decoupled from drive rotor **250** during use, reducing friction and potential wear on seal ring **270** as drive rotor **150** is rotated.

Once the desired tissue is removed, tissue resecting device **10** may be deactivated and removed from the surgical site. Thereafter, end effector assembly **100** may be disengaged from handpiece assembly **200** and discarded (or sent for reprocessing), while handpiece assembly **200** is cleaned and/or sterilized for reuse. As detailed above, upon disengagement of end effector assembly **100** from handpiece assembly **200**, seal **270** is returned to its at-rest position, thus inhibiting fluid ingress into handpiece assembly **200** during sterilization and/or cleaning thereof for reuse.

As an alternative to handpiece assembly **200** configured for manual grasping and manipulation during use, tissue resecting device **10** may alternatively be configured for use with a robotic surgical system wherein handle housing **210** is configured to engage a robotic arm of the robotic surgical system. The robotic surgical system may employ various robotic elements to assist the surgeon and allow remote operation (or partial remote operation). More specifically, various robotic arms, gears, cams, pulleys, electric and mechanical motors, etc. may be employed for this purpose and may be designed with the robotic surgical system to assist the surgeon during the course of an operation or treatment. The robotic surgical system may include remotely steerable systems, automatically flexible surgical systems, remotely flexible surgical systems, remotely articulating surgical systems, wireless surgical systems, modular or selectively configurable remotely operated surgical systems, etc.

The robotic surgical system may be employed with one or more consoles that are next to the operating theater or located in a remote location. In this instance, one team of surgeons or nurses may prep the patient for surgery and configure the robotic surgical system with the surgical device disclosed herein while another surgeon (or group of surgeons) remotely control the surgical device via the robotic surgical system. As can be appreciated, a highly skilled surgeon may perform multiple operations in multiple locations without leaving his/her remote console which can be both economically advantageous and a benefit to the patient or a series of patients.

The robotic arms of the robotic surgical system are typically coupled to a pair of master handles by a controller. The handles can be moved by the surgeon to produce a corresponding movement of the working ends of any type of surgical instrument (e.g., end effectors, graspers, knifes, scissors, cameras, fluid delivery devices, etc.) which may complement the use of the tissue resecting devices described herein. The movement of the master handles may be scaled so that the working ends have a corresponding movement that is different, smaller or larger, than the movement performed by the operating hands of the surgeon. The scale factor or gearing ratio may be adjustable so that the operator can control the resolution of the working ends of the surgical instrument(s).

While several embodiments of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as examples of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

Although the foregoing disclosure has been described in some detail by way of illustration and example, for purposes of clarity or understanding, it will be obvious that certain changes and modifications may be practiced within the scope of the appended claims.

What is claimed is:

1. A tissue resecting device, comprising:
an end effector assembly including a proximal hub housing and a cutting member extending distally from the proximal hub housing; and
a handpiece assembly, including:
a handle housing;
a drive casing extending distally from the handle housing;
a drive rotor extending through and distally from the drive casing; and
a seal ring disposed about the drive rotor, the seal ring having an at-rest position and a displaced position, wherein, in the at-rest position, the seal ring is sealingly engaged between the drive casing and the drive rotor to inhibit fluid ingress into an annular space defined therebetween, and wherein, in the displaced position, the seal ring is displaced from the drive rotor to reduce friction therebetween upon rotation of the drive rotor relative to the drive casing,
wherein, the end effector assembly is releasably engagable with the handpiece assembly and wherein, upon engagement of the end effector assembly with the handpiece assembly, a portion of the proximal hub housing is configured to urge the seal ring from the at-rest position to the displaced position, and
wherein, with the end effector assembly engaged with the handpiece assembly, the drive rotor is coupled to the cutting member and configured to drive rotation and reciprocation of the cutting member.

2. The tissue resecting device according to claim **1**, wherein the end effector assembly further includes an inner core disposed within the proximal hub housing, the cutting member coupled to the inner core and the inner core configured to couple to the drive rotor upon engagement of the end effector assembly with the handpiece assembly such that rotation of the drive rotor drives the rotation and reciprocation of the cutting member.

3. The tissue resecting device according to claim **1**, wherein the end effector assembly further includes a fixed outer shaft extending distally from the proximal hub housing and disposed about the cutting member.

4. The tissue resecting device according to claim **1**, wherein the proximal hub housing defines bayonet threading and wherein the drive casing defines bayonet threading configured to engage the bayonet threading of the proximal hub housing to engage the end effector assembly with the handpiece assembly.

5. The tissue resecting device according to claim **1**, wherein the handpiece assembly further includes a motor disposed within the handle housing, the motor configured to drive rotation of the drive rotor.

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